L5 Plug-In Conversion Module

Service Manual

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Release 01
401567-001

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Contents

Chapter 1

Installation Kit and Tools

This chapter includes the following sections:

CAUTION

The Hymotion L5 Plug-In Conversion Module (PCM) must be installed by A123 Systems' certified technicians.

Installation Kit

The contents of the installation kit are described in Table 1-1.

Table 1-1 Installation kit contents

Description	Item Qty	Illustration	Part Number
1. L5 PCM INSTALLATION KIT	1		401137-001
2. CARDBOARD BOX	1		401134-001

Table 1-1 Installation kit contents

Description	Item Qty	Illustration	Part Number
3. EXHAUST MANIFOLD	1		400881-001
4. GASKET, EXHAUST MANIFOLD	1		401086-001
5. VEHICLE INSTALLATION HARNESS	1		400772-001
6. PRIUS MOUNT BRACKET– REAR LEFT	1		400941-001
7. PRIUS MOUNT BRACKET– REAR RIGHT	1		400690-001

Table 1-1 Installation kit contents

Description	Item Qty	Illustration	Part Number
8. SCREW, MACHINE, HEX HEAD, M10 X1.5, 40 MM LG, STEEL, PHOSPHATE COAT, CONICAL WASHER	2		900021-2809
9. M10-1.5 FLANGE NUT	2		900030-0587
10. SCREW MACHINE HEX HEAD M8 X 1.25 30 MM LG STEEL ZN PLATED CONICAL WASHER 13 MM HEX	4		900021-2011
11. ZIP TIES	30		400760-001x10 401149-001x20
12. MARINCO CHARGE PORT	1		400789-001
13. ALUMINUM BACKING PLATE	1		400439-001

Table 1-1 Installation kit contents

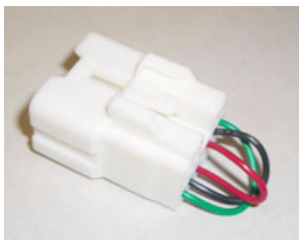
Description	Item Qty	Illustration	Part Number
14. SCREW MACHINE BUTTON HEAD M4X0.7 40 MM LG STAINLESS 18-8 PLAIN FULLY THREADED HEX 2.5 MM (to secure Marinco charge port)	2		900019-5603
15. HOSE CLAMP FOR CHARGE PORT	1		401153-001
16. FIR TREE PANEL FASTENER 5/16 X 1 LG	3		401150-001
17. NUT HEX M6X1.0 10 MM SOCKET STEEL ZN PLATED CONICAL WASHER	1		900030-0361
18. PLUG FASTENER, FIR TREE, NYLON, 0.70X0.54	10		400982-001
19. PLUG – CAN AND INTERLOCK BRIDGE	1		401129-001

Table 1-1 Installation kit contents

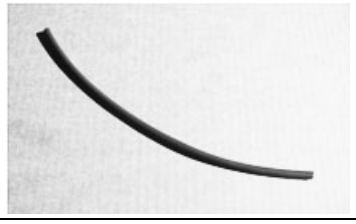
Description	Item Qty	Illustration	Part Number
20. BRACE – OEM BATTERY PRIUS	1		400704-001
21. EXHAUST DUCT CONNECTOR	1		400882-001
22. ZIPLOCK BAG	1		400089-001
23. HEX NUT M5x0.8 8MM	6		900030-0034
24. HEATSHRINK 3/16” ID 12” LONG	1		900314-001
25. HEX NUT M10x1.5 10MM	2		900030-0587

Table 1-1 Installation kit contents

Description	Item Qty	Illustration	Part Number
26. BARREL STEP DOWN CRIMP 22-18AWG (38054)	2		401680-001
27. BARREL BRAZED SEAM 22-18AWG (30260)	8		401682-001
28. SCOTCHLOCK MALE TERMINAL	1		401683-001
29. SCOTCHLOCK FEMALE TERMINAL	1		401685-001
30. CAUTION LABEL	1		401953-001
31. NOISE/VIBRATION MAT (RIGHT)	1		401084-001

Table 1-1 Installation kit contents

Description	Item Qty	Illustration	Part Number
32. NOISE/VIBRATION MAT (LEFT)	1		401159-001

Required Tools

The required tools are described in Table 1-2.

Table 1-2 Required tools

Description	Required Tools
1. HV INSULATED GLOVES (INSPECTED FOR LEAKS AND DAMAGES)	
2. MULTI METER	
3. CORDLESS DRILL	

Table 1-2 Required tools

Description	Required Tools
4. CORDLESS IMPACT WRENCH	
5. ADAPTORS FOR IMPACT WRENCH (3/8 AND 1/4 INCH DRIVE)	
6. FLASH LIGHT	
7. SOLDERING IRON	
8. SOLDER	

Table 1-2 Required tools

Description	Required Tools
9. WIRE STRIPPERS	
10. PRY BAR	
11. DIAGONAL CUTTER	
12. NEEDLE NOSE PLIERS	
13. 8, 10, 12 MM RATCHETING WRENCHES	

Table 1-2 Required tools

Description	Required Tools
14. METRIC WRENCH	
15. UNIBIT EXTENSION AND 1/2 INCH UNIBIT	
16. 9/16 INCH UNIBIT	
17. 3/8 INCH DRIVE RATCHET	
18. 3/8 INCH DRIVE AND 8 INCH EXTENSION	

Table 1-2 Required tools

Description	Required Tools
19. 3/8 AND 1/4 INCH METRIC SOCKET SETS	
20. MAGNETIC PICK UP TOOL AND MIRROR	
21. SCREW DRIVERS (PHILIPS AND STRAIGHT)	
22. ELECTRICAL TAPE	
23. 1 3/4 INCH HOLE SAW	

Table 1-2 Required tools

Description	Required Tools
24. LATCH HOOKS	 McMaster Part # 8836T42
25. SLINGS	 McMaster Part # 9073T402
26. CRIMPING TOOL (CHANNEL LOCK 909 "*THE CRIMPER*")	
27. HEAT GUN	
28. SHOP VACUUM	

Chapter 2

Installation Preparation

This chapter includes the following section:

Safety Overview

The L5 PCM operates at a high voltage. Improper handling could cause an electric shock. Follow all precautions while servicing the vehicle.

Do not touch the high voltage connectors or terminals for five minutes after removing the service plug grip. Do not reconnect the service plug while you are servicing the vehicle.

The L5 PCM's energy is high enough to sustain an ARC flash. Personal Protective Equipment (PPE) is required while servicing the vehicle.

Wait at least 90 seconds after disconnecting the cable from the negative (-) 12V battery terminal before servicing the vehicle. This prevents activating the air bag or seat belt pretensioner.

The L5 PCM weighs ~180 pounds. Take precaution when lifting the L5 PCM.

Preparing for the Installation

Table 2-1 provides L5 PCM pre-installation instructions.

Table 2-1 Pre-installation steps

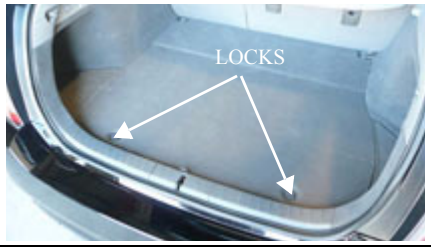
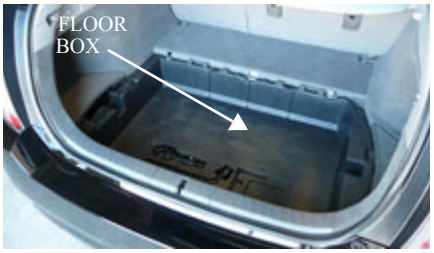
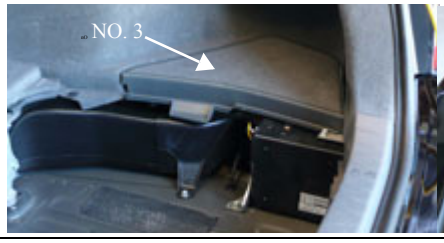
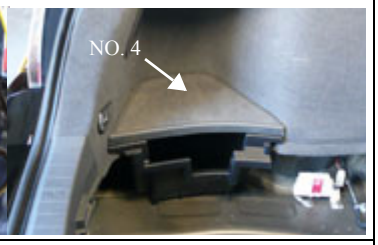
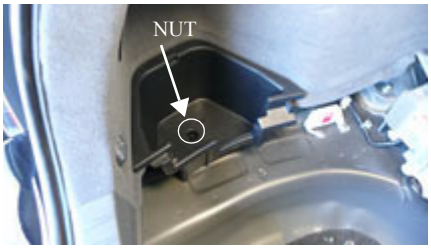
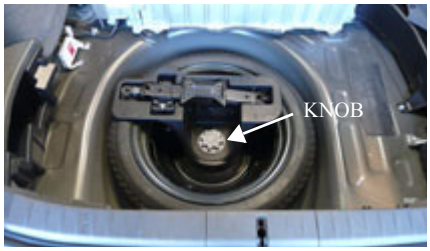
Description	Illustration
1. REMOVE THE NO. 2 FLOOR BOARD a. Release the locks by turning their knobs. b. Remove the No. 2 floor board.	
2. REMOVE THE REAR DECK FLOOR BOX a. Remove the floor box.	
3. REMOVE THE REAR FLOORBOARDS a. Remove the right side floor board No. 3. b. Remove the left side floor board No. 4.	 
4. REMOVE THE DECK FLOOR BOX LH a. Unscrew the 10mm plastic nut. b. Remove the nut c. Remove the deck floor box.	
5. REMOVE THE JACK ASSEMBLY AND SPARE TIRE a. Turn knob counter-clockwise. b. Remove the jack. c. Remove the spare tire.	

Table 2-1 Pre-installation steps

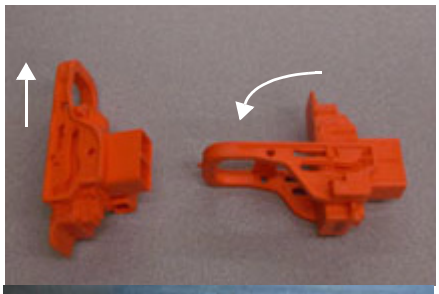
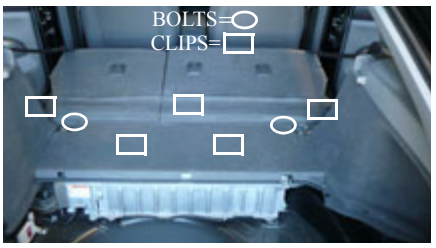
Description	Illustration
6. DISCONNECT THE AUXILIARY BATTERY FROM THE GROUND a. Disconnect the 12V auxiliary battery from the chassis ground under the right rear floorboard. b. Locate wire away from ground.	
7. REMOVE THE TONNEAU COVER a. Remove the cover.	
8. REMOVE THE SERVICE PLUG GRIP **WARNING – Be sure to wear insulating gloves for the following procedure.** a. Slide the lever of the service plug grip to the up position. b. Remove the service plug grip while turning the lever to the left. **NOTE: Do not operate the power switch after removing the service plug grip. This could damage the vehicle's control ECU.**	 
9. REMOVE THE NO. 1 FLOOR BOARD a. Fold down the back seat. b. Remove the 2 bolts that secure the luggage hold "D" rings. c. Remove the 5 clips and rear floor board.	

Table 2-1 Pre-installation steps

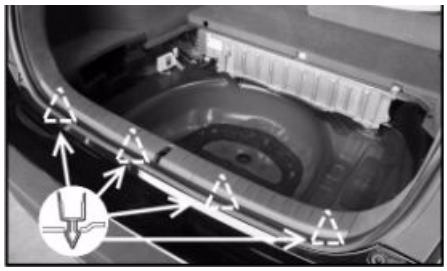
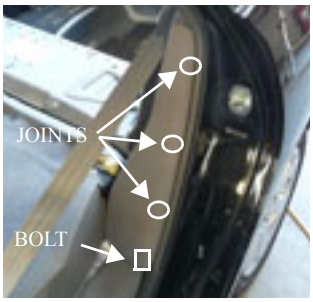
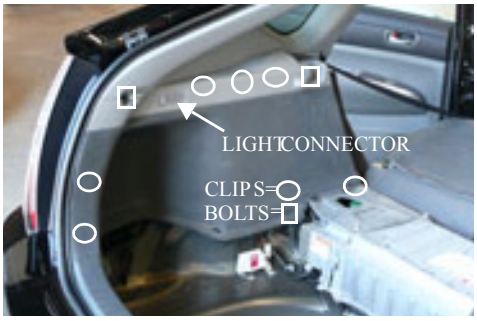
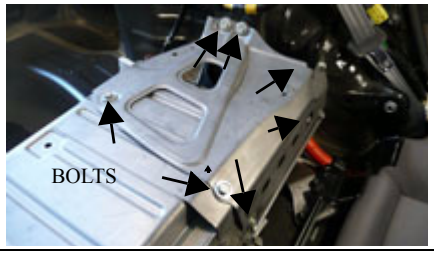
Description	Illustration
10. REMOVE THE REAR DECK TRIM COVER a. Remove the deck trim cover by pulling up firmly.	
11. REMOVE THE REAR SIDE SEAT BACK FRAME LH a. Remove the bolt from the right rear seat back side bolster. b. Slide up to undo the 3 joints and remove the right rear seat back side bolster.	
12. REMOVE THE DECK TRIM PANEL LH a. Remove the bolt and luggage hold “D” ring. b. Remove the fir tree fastener from the deck trim side panel. c. Remove the 2 bolts from the deck trim side panel. d. Undo the 6 clips, and remove the deck trim side panel. e. Disconnect the lighting connector.	
13. REMOVE THE BATTERY CARRIER BRACKET a. Remove the 7 bolts. b. Remove the battery carrier bracket.	

Table 2-1 Pre-installation steps

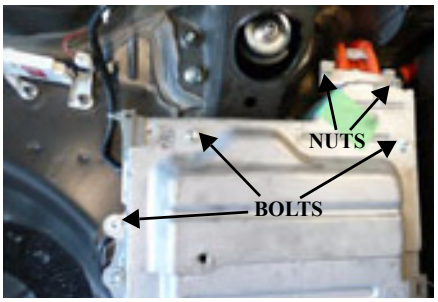
Description	Illustration
14. REMOVE THE BATTERY CARRIER PANEL a. Remove the 3 bolts and 2 nuts. b. Remove the battery carrier panel.	
15. REMOVE THE FRONT SCUFF PLATE LH. a. Remove the scuff plate by pulling up firmly.	
16. REMOVE THE COWL SIDE TRIM BOARD LH a. Remove the trim board by pulling up firmly.	
17. REMOVE THE REAR SCUFF PLATE LH a. Remove the scuff plate by pulling up firmly.	

Table 2-1 Pre-installation steps

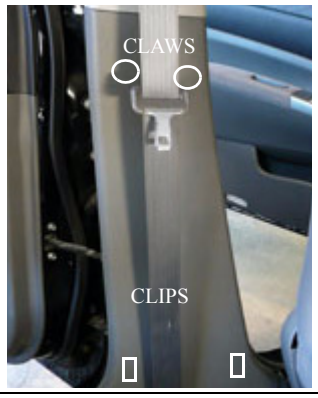
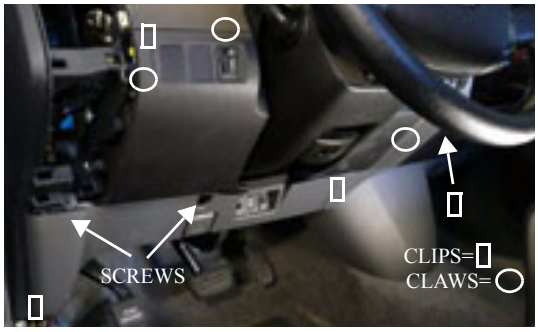
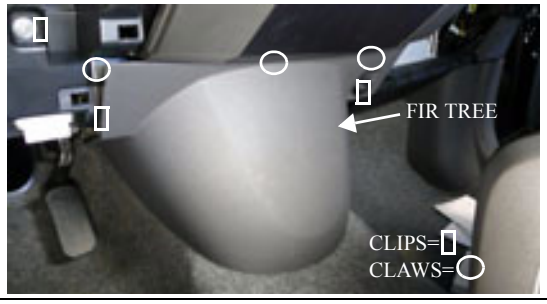
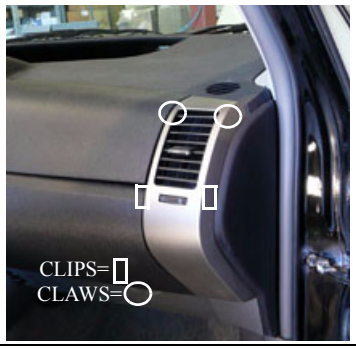
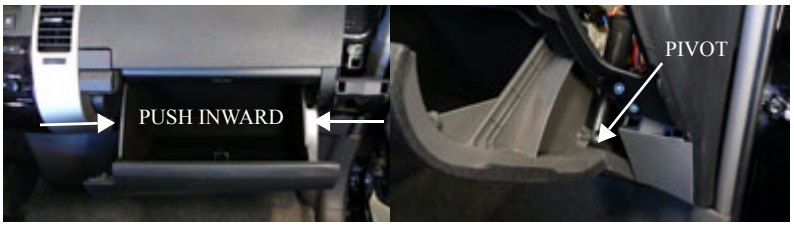
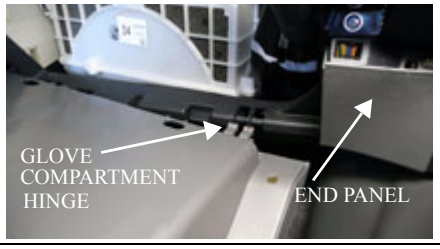
Description	Illustration
18. REMOVE THE CENTER PILLAR LOWER GARNISH LH a. Detach the lower half of the B Pillar trim.	
19. REMOVE THE INSTRUMENT PANEL REGISTER ASSEMBLY LH a. Remove the instrument panel register by pulling firmly.	
20. REMOVE THE LOWER INSTRUMENT FINISH PANEL SUB-ASSEMBLY a. Remove the 2 screws. b. Disconnect the hood control cable. c. Pull panel firmly to reveal plug connection. d. Detach all plug connectors (smart key, dimmer, etc).	
21. REMOVE THE UPPER INSTRUMENT FINISH PANEL SUB-ASSEMBLY a. Pull the finish panel to reveal the “POWER” button connector. b. Disconnect the “POWER” button connector. c. Remove the finish panel by pulling firmly.	

Table 2-1 Pre-installation steps

Description	Illustration
22. REMOVE THE CENTER LOWER INSTRUMENT FINISH PANEL a. Remove the fir tree clip from the right side. b. Detach the accessory outlet connector. c. Remove the center lower finish panel.	
23. REMOVE THE NO. 2 INSTRUMENT PANEL REGISTER ASSEMBLY RH a. Remove the instrument panel register by pulling firmly.	
24. REMOVE THE GLOVE COMPARTMENT DOOR ASSEMBLY a. Push the slide inward to allow pins to pass frame. b. Remove the glove compartment strut by detaching it from lower pivot. c. Pull the glove compartment away from hinge.	
25. REMOVE THE FINISH END PANEL a. Remove the finish end panel from the vehicle.	

Chapter 3

Connecting the Wiring Harness

This chapter includes the following sections:

Connecting the CAN and Power

Table 3-1 provides instructions for connecting the CAN and power.

Table 3-1 CAN and power

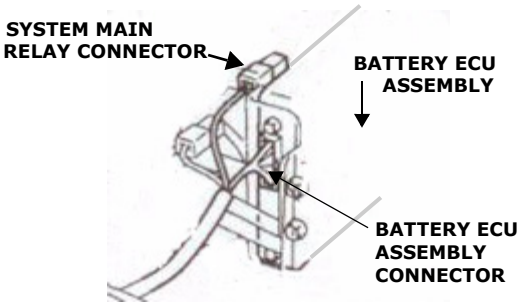
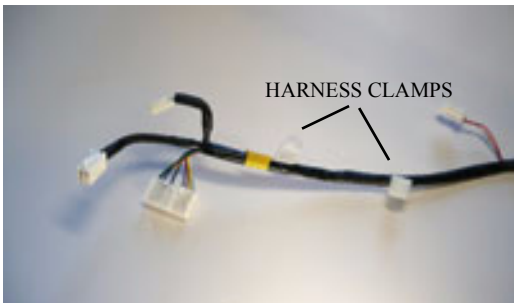
Description	Illustration
1. LOCATE THE OEM WIRING CONNECTORS AT THE LEFT OF THE OEM HV BATTERY a. Disconnect the system main relay connector. b. Remove the clamp and disconnect the Battery ECU Assembly Connector.	
2. REMOVE THE HARNESS CLAMPS FROM THE HARNESS a. Remove the harness clamps. b. Straighten the harness bends.	

Table 3-1 CAN and power

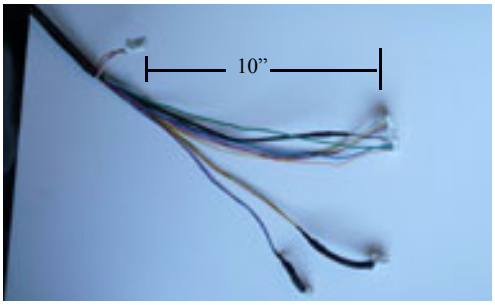
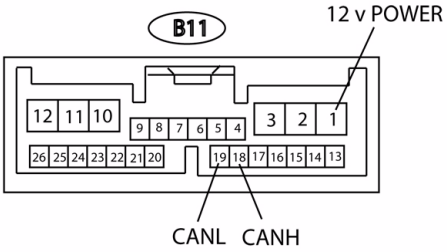
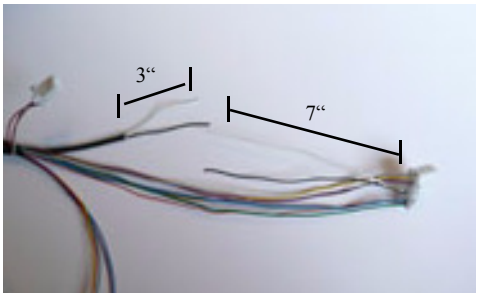
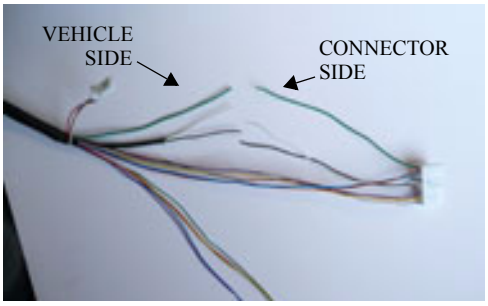
Description	Illustration
3. PREPARE OEM HARNESS FOR INTEGRATION. a. Remove 10 inches (254mm) of electrical tape and sleeve from battery harness. **NOTE:** This leaves the small diameter corrugated loom intact.	
4. BATTERY ECU CONNECTOR – B11 PINOUT B11 pinouts are as follows: **B11 POS 1 = 12V Power** **B11 POS 18 = CAN H** **B11 POS 19 = CAN L**	
5. CUT THE CAN H AND CAN L WIRES a. Cut the CAN H and CAN L wiring (B11 – pins 18 & 19) 7 inches (177.8 mm) from back face of B11. b. Remove 3 inches (76.2 mm) of outer insulation and EMI shielding from both pairs of CAN wires. c. Strip back a 1/4 of an inch (6.35mm) of insulation from CAN H and CAN L.	
6. CUT 12V POWER a. Cut 12V Power to Battery ECU (B11 – pin 1) 7 inches (177.8 mm) from the back face of the B11. b. Strip back a 1/4 of an inch (6.35mm) of insulation from both cut ends.	

Table 3-1 CAN and power

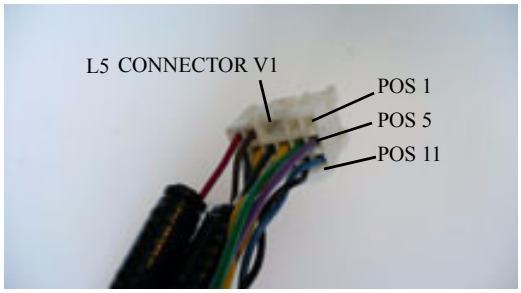
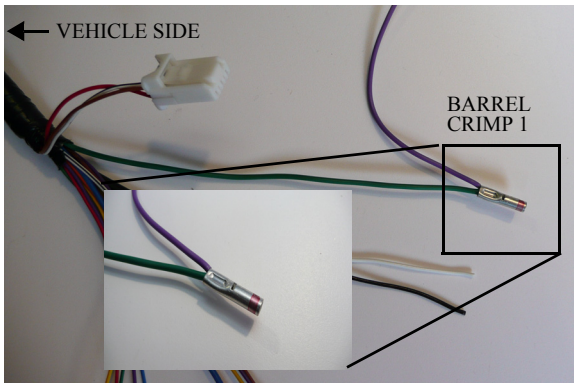
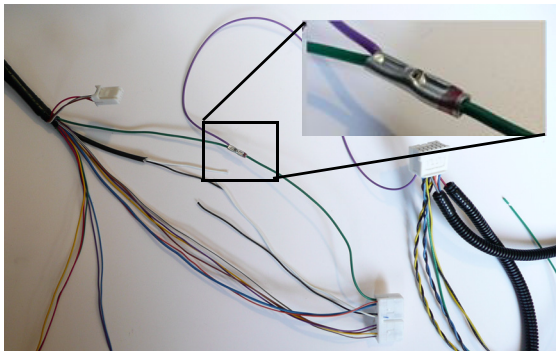
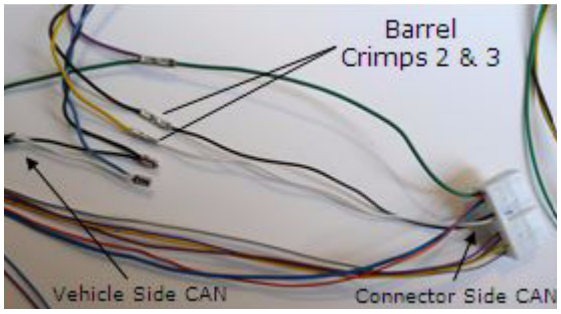
Description	Illustration
7. L5 CONNECTOR V1 a. Use illustration as a reference for the following steps. **NOTE:** Reference Table A-1 on page A-1 for the connector V1 pinouts.	
8. BARREL CRIMP 1 a. Double crimp V1 pin 5 to Vehicle Side of B11 pin 1 using the non-marked end of barrel crimp (A123Systems Part Number 401680-001).	
9. RECONNECTING 12V POWER a. Insert heat shrink tubing on the connector side of B11 pin 1. b. Attach other end of 12V power connector with barrel crimp 1 (marked with a red stripe).	
10. BARREL CRIMPS 2 & 3 – CONNECTOR SIDE CAN a. Secure the barrel crimps (A123 Systems Part Number 401682-001) to the connector side of B11 pins 18 & 19. b. Insert heat shrink tubing on both wires. c. Crimp the connector side CAN to the L5 V1 connector as follows: **- B11 pin 19 to V1 pin 9** **- B11 pin 18 to V1 pin 10**	

Table 3-1 CAN and power

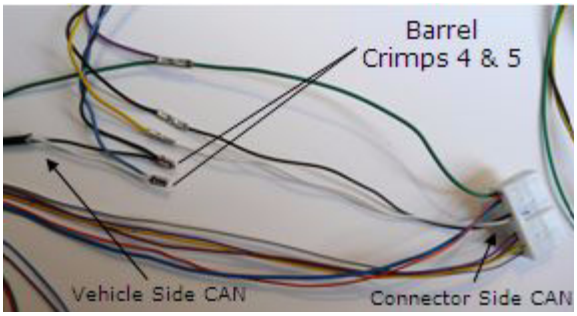
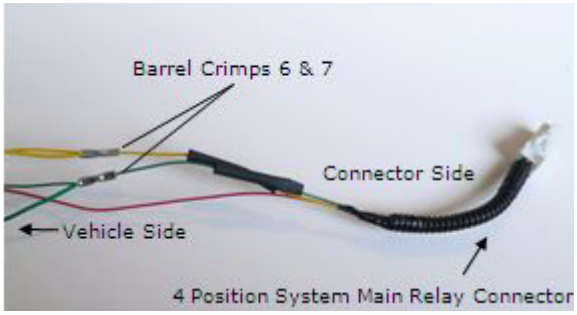
Description	Illustration
11. BARREL CRIMPS 4 & 5 – VEHICLE SIDE CAN a. Double crimp the vehicle side CAN wiring using barrel crimps (A123 Systems Part Number 401682-001) as follows: **- B11 pin 19 to V1 pin 12** **- B11 pin 18 to V1 pin 11** b. Cover all the connections with heat shrink tubing, pinching together the empty end of tubing on the barrel crimps 4 & 5.	
12. BARREL CRIMPS 6 & 7 – SYSTEM MAIN RELAY CONNECTIONS a. Cut the yellow and green wires 7 inches (177.8mm) from the back face of the System Main Relay connector. b. Strip back a 1/4 of an inch (6.35mm) of insulation from each end and insert 1.5” heat shrink tubing on the wires. c. Double crimp the vehicle side of the system main relay (yellow and green wires) with the L5 V1 harness using barrel crimps (A123 Systems Part Number 401682-001) as follows: **- System main relay yellow to V1 pin 7** **- System main relay green to V1 pin 6** d. Secure the other end of the barrel crimps 6 & 7 to the connector side of the system main relay harness. Verify proper color combinations. e. Cover all connections with heat shrink tubing.	

Table 3-1 CAN and power

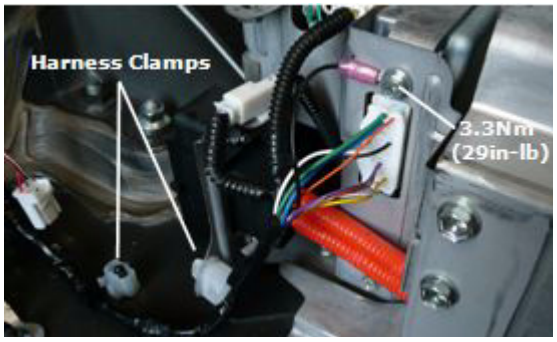
Description	Illustration
13. INSULATE THE L5 AND OEM WIRE HARNESS a. Bundle all connected wires from the connector V1 and secure with electrical tape. b. Replace the rubber protective sleeve from the OEM harness. c. Include the black wire from the connector V1 pin 8 verifying that the ring terminal is close to the connector B11.	
14. INSTALL THE OEM AND THE L5 HARNESS INTO VEHICLE a. Reconnect the 3 battery ECU assembly connectors. b. Attach both OEM harness clamps to the harness. c. Install the harness into the vehicle. d. Secure the L5 V1 pin 8 ground terminal to the battery ECU mounting screw (3.3 Nm, 29in-lb).	
15. ROUTE THE BRAKE LIGHT INDICATOR WIRE a. Route the brake light indicator up the shock support structure using the recommended tie points. b. Secure the brake light indicator wire V1 pin 4 (red conductor in 1/4 of an inch (.635mm) corrugated split loom) to the inner wheel well.	

Table 3-1 CAN and power

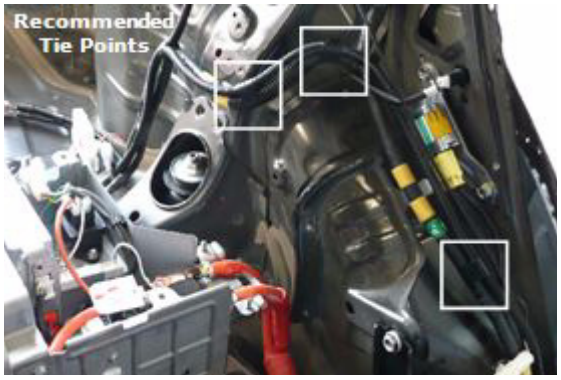
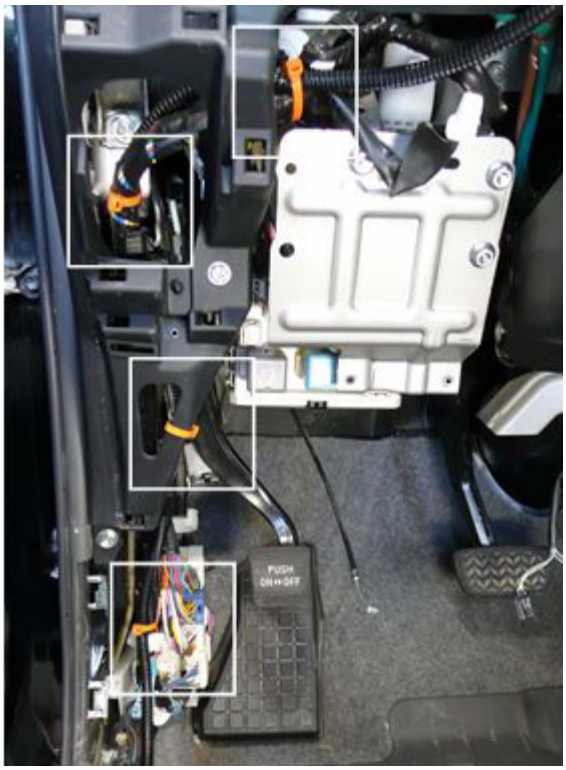
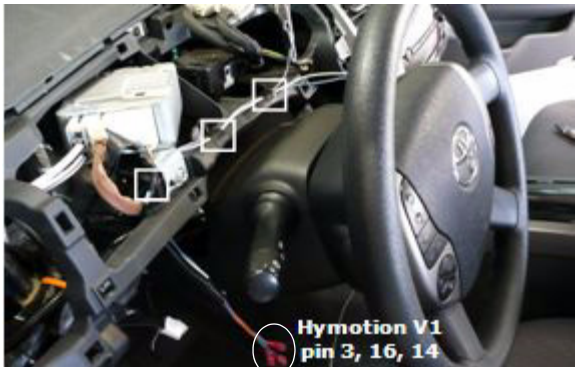
Description	Illustration
16. LOCATE THE BRAKE LAMP CONNECTOR R9 a. Locate the left brake light connector R9. b. Strip back the insulation on the blue wire R9 pin 5, 1.5 inches from back face of R9 connector. Solder red wire from Hymotion V1 pin 4 in parallel. c. Cover connection in electrical tape for isolation. d. Secure loose wiring and replace connector R9 into the brake light assembly.	
17. ROUTE THE L5 HARNESS – VEHICLE REAR a. Secure the L5 wire harness to the OEM wire harness running along the top left rear shock tower.	

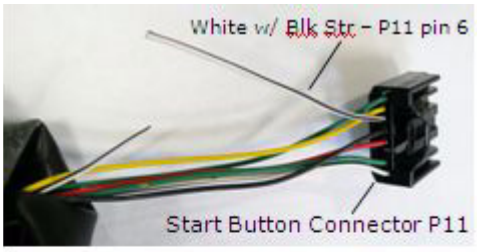
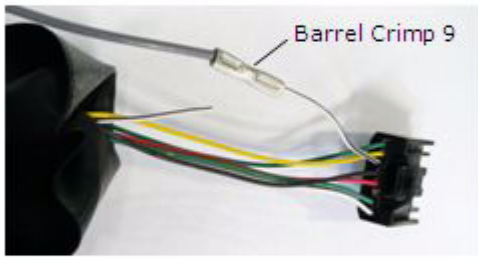
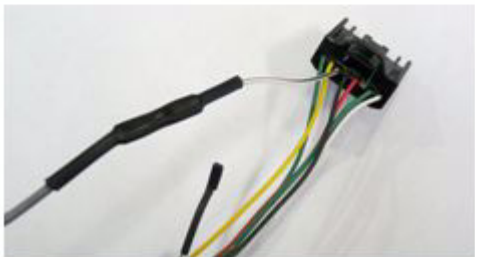
Table 3-1 CAN and power

Description	Illustration
18. ROUTE THE L5 HARNESS – DOOR SILLS AND A PILLAR a. Secure the L5 harness along the rear and front left door sills using the OEM harness clamps. b. Secure the L5 harness along the OEM wire harness (located alongside the A Pillar support column) using zip ties. **NOTE:** Take extra care to avoid interfering with the emergency park brake assembly.	
19. ROUTE THE L5 HARNESS – INSTRUMENT PANEL a. Route the L5 harness to the OEM dimmer connector with the following wires: **- V1 pin 3 (brown)** **- V1 pin 16 (blue)** **- V1 pin 14 (orange)** b. Route the remainder of the L5 harness, along the top of the instrument panel, and secure it.	

Connecting the Start Button Interlock

Table 3-2 provides instructions for connecting the start button interlock.

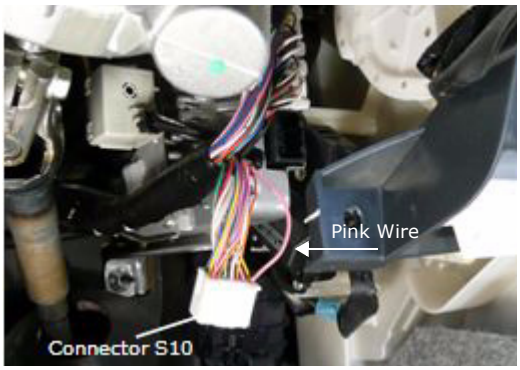
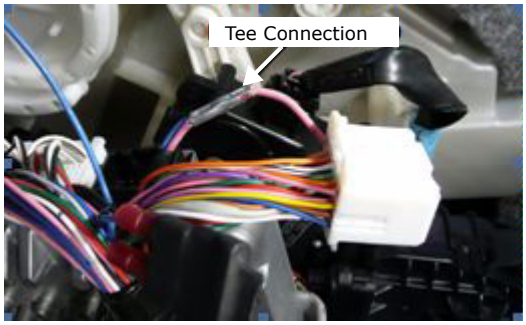
Table 3-2 Start button interlock

Description	Illustration
1. BARREL CRIMP 9 – START BUTTON INTERLOCK CONNECTION a. Peel back a 5 inch (127mm) section of the OEM rubber insulation from the Start Button harness. b. Locate the white/black stripe wire toward the center of the connector P11 pin 6. c. Cut the wire from P11 pin 6 approximately 3 inches (76.2mm) from the back face of P11. d. Strip back 3/4 of an inch (6.35mm) of insulation from the connector side and insert heat shrink over wire. e. Attach the L5 V1 pin 13 to the connector side of P11 pin 6. f. Cover with 1.5 inches of heat shrink tubing using the barrel crimp (A123 SYSTEMS PART NUMBER 401682-001). **NOTE:** Make sure to isolate unused harness side of P11 pin 6 with additional heat shrink.	  
2. INSULATE AND ROUTE WIRES a. Cover the start switch connection with OEM rubber insulation and secure any extra wire. b. Route the remaining blue and white wires to the right of the IP support.	

Connecting the ABS Remote Wire

Table 3-3 provides instructions for connecting the ABS remote wire.

Table 3-3 ABS remote wire

Description	Illustration
1. REMOVE THE WHITE AIR DEFLECTOR HOUSING BELOW THE STEERING COLUMN a. Remove the fir tree connector. b. Pull the housing firmly down and to the left.	
2. LOCATE THE SKID CONTROL UNIT – LOWER DASH a. Remove the bottom most connector from the skid control unit. b. Locate the large pink wire on the S10 pin.	
3. SKID CONTROL ECU CONNECTION a. Strip back insulation 1/2 inch into pink wire, S10 pin 1, 1.5 inches from back face of S10 with Hymotion V1 pin 16. Solder in parallel. Do not cut pink wire. b. Cover connection in electrical tape for isolation. c. Secure integrated fuse to vehicle harness. d. Reconnect the S10 pin into the skid control ECU and replace the floor vent.	 

Connecting the EV Button Pin

Table 3-4 provides instructions for connecting the EV button pin.

Table 3-4 EV button pin

Description	Illustration
1. ROUTE THE WHITE EV WIRE – V1 pin 15 a. Route the remaining white wire behind the lower center panel trim. b. Route the wire above the cabin air filter toward the Hybrid Control ECU. c. Secure the wire.	
2. INSERT THE L5 EV SIGNAL WIRE (V1 PIN 15) INTO THE HYBRID CONTROL ECU **NOTE:** Reference Figure 3-1 on page 3-11 for the following steps. a. Locate the H16 connector and gently pull the white tab out of connector 1/8 of an inch (3.2mm) to release the pin lock. b. Trim the right hand side key feature on the EV signal wire pin before inserting into the H16 pin 27. c. Reattach the plug into the HV ECU.	

Connecting to the HV ECU

Figure 3-1 illustrates the HV ECU and its location in the vehicle.

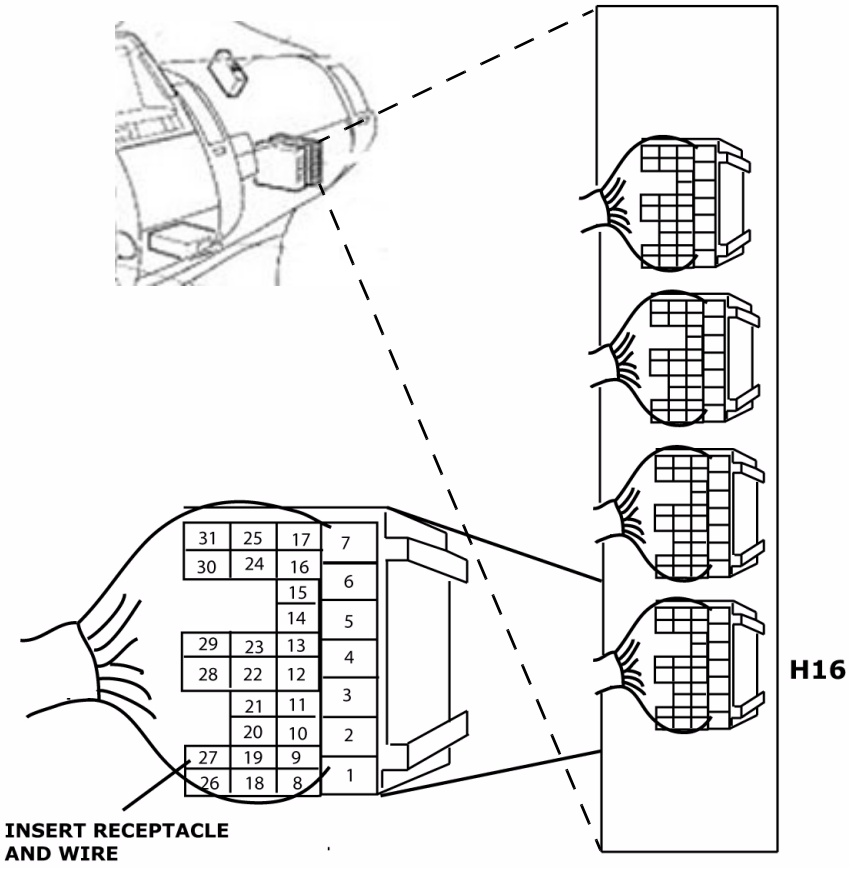


Figure 3-1 HV ECU

Installing the Enable Switch

Table 3-5 provides instructions for installing the system enable switch.

Table 3-5 System enable switch

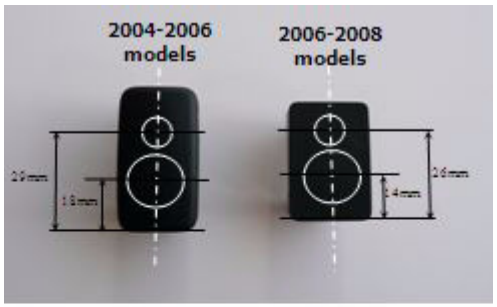
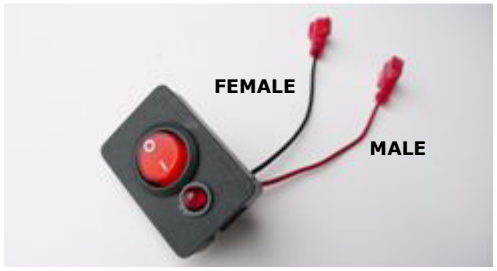
Description	Illustration
1. REMOVE THE SMALL BLANK ACCESSORY PANEL FROM THE LOWER TRIM PANEL a. Push out the blank panel from the trim panel.	
2. MOUNT THE ENABLE SWITCH AND LED INTO PANEL a. Drill a 9/16 (15 mm) and 1/4 inch (6.38 mm) hole into the blank accessory dash panel. b. Mount the enable switch and LED indicator into the drilled holes. c. Crimp the male spade terminal to the red LED indicator. Crimp the female spade terminal to the black LED indicator.	 
3. a. Mount the negative ring terminal of the LED to a ground location behind the accessory dash panel.	
4. REASSEMBLE IN THE REVERSE ORDER.	

Table 3-5 System enable switch

Description	Illustration
5. RE-INSTALL THE UPPER AND LOWER DASH PANELS a. Feed the blue, brown, orange, and black wires through the small panel opening before securing the lower panel. b. Connect the brown and black wires to the LED indicator. c. Connect the orange and blue wires to the 2 silver posts on the switch. d. Insert the connected accessory panel and wires into the lower dash.	

Chapter 4

Installing the L5 PCM to the Vehicle

This chapter includes the following sections:

Installing the L5 PCM

NOTE

Verify that you have documented the L5 PCM serial number on the customer repair order before installing the unit to the vehicle.

Table 4-1 provides installation instruction for the L5 PCM.

Table 4-1 Installing the L5 PCM

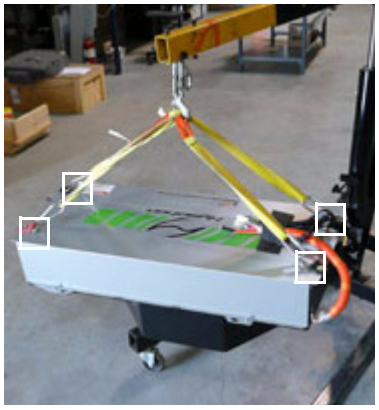
Description	Illustration
1. REMOVE THE L5 PCM FROM SHIPPING CRATE a. Remove the bolts at the top 4 corners of the L5 PCM. b. Attach the lifting hooks. (McMaster Part # 8836T42) c. Attach the slings onto the lifting hooks. (McMaster Part # 9073T402) **NOTE:** Note the serial number, from the side panel of the L5 PCM before lowering it into the vehicle. **TIP**: Secure the L5 cables.	

Table 4-1 Installing the L5 PCM

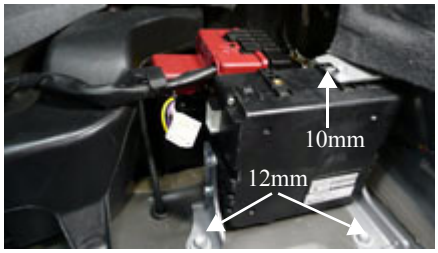
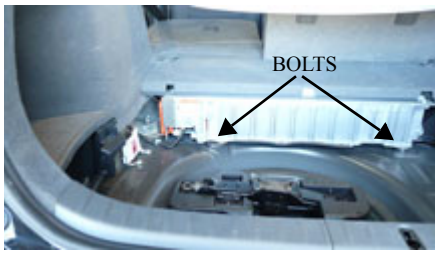
Description	Illustration
2. ATTACH THE EXHAUST MANIFOLD a. Lower the L5 PCM onto the work surface. b. Attach the gasket to the exhaust manifold. c. Attach the exhaust manifold to the L5 PCM using 8 fir tree plug fasteners.	
3. PREPARE THE RIGHT SIDE MOUNTING a. Remove the ABS control unit connector. b. Remove (2) 12 mm bolts. c. Remove (1) 10 mm bolt. d. Remove the ABS control unit from vehicle.	
4. PREPARE THE FRONT MOUNTING a. Remove and discard the (2) 12 mm bolts from the back mounting of the OEM battery.	
5. POSITIONING THE MATS a. Position the noise / vibration mats on the left and right trunk floor area.	
6. LOWER THE L5 PCM INTO THE VEHICLE a. Rotate the L5 PCM through the hatch opening. b. Lower the L5 PCM into the trunk of vehicle. c. Reposition the noise / vibration mats as required.	

Table 4-1 Installing the L5 PCM

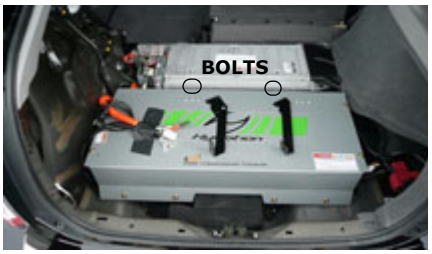
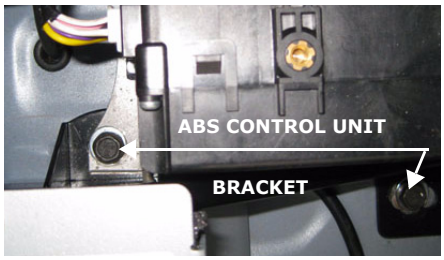
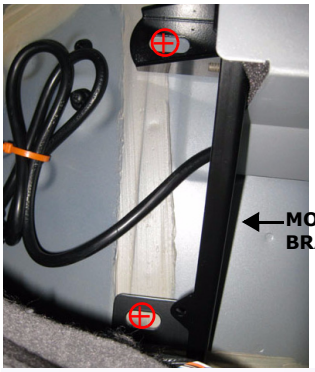
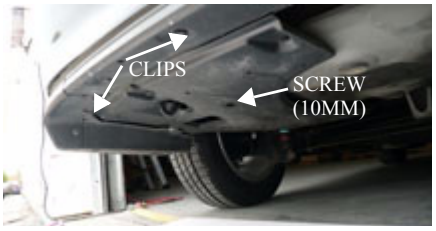
Description	Illustration
7. SECURE THE L5 PCM TO VEHICLE a. Install 2 black hardened M8-1.25x30 mm bolts at the front of the L5 PCM and the back of the OEM battery mounting locations. b. Install 2 black hardened M8-1.25x30 mm bolts to the right side of the PCM securing ABS control unit in place. c. Reconnect the ABS connection.	 
8. LEFT SIDE MOUNTING HOLE PROCEDURE a. Install the LH mount bracket to the left side of the L5 PCM. b. Use a Unibit with extension to drill a 1/2 inch (12.7 mm) hole for the left side L5 PCM mount and the LH mount bracket. Favor the left side of the openings, as indicated in the illustration (+), when drilling the holes. c. Insert 2 M10-1.5 X 40 mm bolts into the 1/2 inch (12.7 mm) holes. **NOTE:** Vacuum the drill shavings after drilling the holes.	 
9. SECURE THE 2 M10-1.5 X 40 MM BOLTS ON LR OF L5 PCM a. Remove the 2 clips and 1 screw (that secure the plastic tray) from the back underside of the car. b. Attach the washers and nuts to the 2 M10-1.5 X 40 mm bolts. c. Reinstall the plastic tray.	

Table 4-1 Installing the L5 PCM

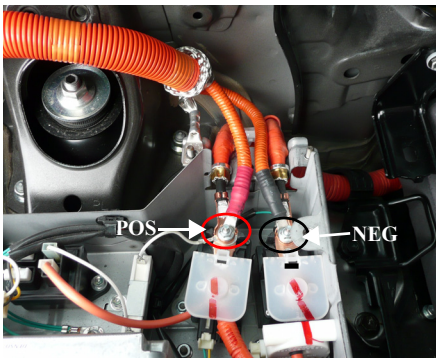
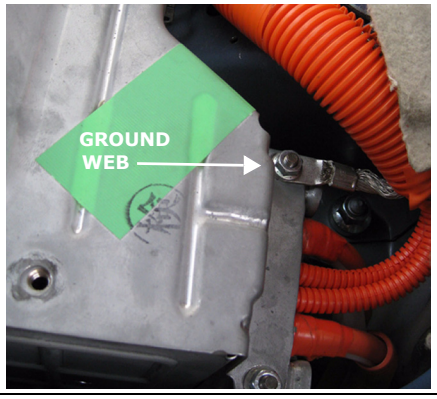
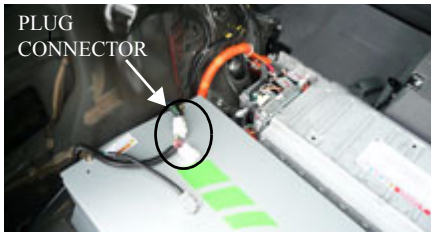
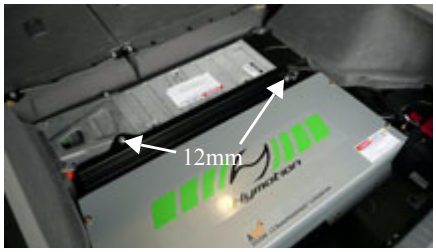
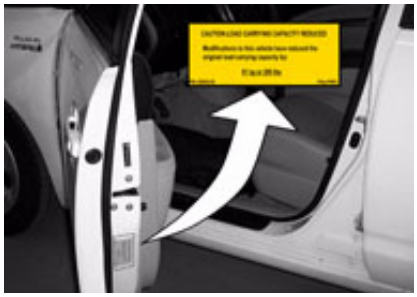
Description	Illustration
10. SECURE THE HIGH VOLTAGE LEADS IN PARALLEL WITH THE OEM BATTERY a. Attach the negative lead to the front terminal location. b. Attach the positive lead to the rear terminal location. **NOTE:** Torque: 3.4 N*m (35 kgf*cm, 30 in*lbf)	
11. INSTALL THE BATTERY CARRIER PANEL AND GROUND WEB a. Position the Battery Carrier Panel. b. Install the Ground Web onto the rear carrier panel stud. c. Secure the Carrier Panel with (3) 10mm bolts and (2) 10 mm nuts.	
12. CONNECT THE COMMUNICATION AND BRIDGE PLUG CONNECTORS a. Attach the CAN and Interlock bridge plug to the PCM harness using a zip tie. b. Connect the bridge plug to the vehicle-side harness.	
13. INSTALL THE BRACE FOR THE OEM BATTERY a. Remove the (2) 12mm bolts. b. Position the brace and secure with the same OEM hardware.	

Table 4-1 Installing the L5 PCM

Description	Illustration
14. PREPARE NO. 1 FLOOR BOARD FOR REINSTALLATION a. Trim the reinforcement tabs. b. Install a replacement fir tree connector.	
15. ATTACH THE LOAD LABEL TO THE VEHICLE'S DOOR JAM. a. Attach the load label as illustrated.	

Installing a Charge Port and Exhaust Duct

Install the 120V charge port and exhaust duct as described in Table 4-2.

Table 4-2 Installing the charge port and exhaust duct

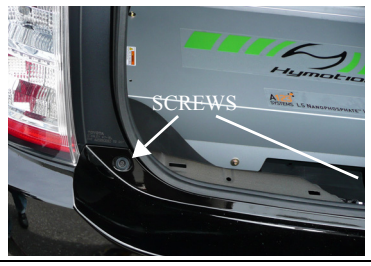
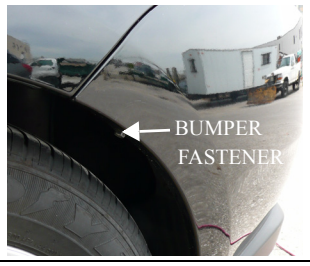
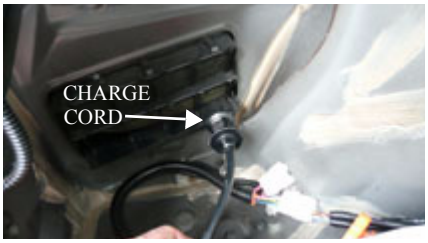
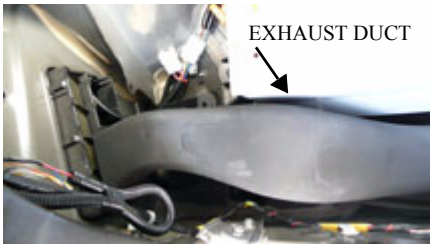
Description	Illustration
1. DETACH THE LEFT SIDE OF THE REAR BUMPER COVER a. Remove the 2 phillip screws from the top of the bumper cover. b. Remove the 10mm bumper fastener from the LR wheel well.	 
2. DRILL HOLES FOR CHARGE SOCKET a. Drill (1) 1 3/4 inch hole for the charge port receptacle. b. Drill (2) 3/16 inch holes for the charge port mounting screws. c. Place charge port tunnal thru opening to locate the port location. **NOTE:** Template is used for illustration purposes and is not included with the kit.	

Table 4-2 Installing the charge port and exhaust duct

Description	Illustration
3. SECURE THE CHARGE RECEPTICLE a. Pass the Marinco charge receptacle, with gasket, through the opening. b. Secure the Marinco charge receptacle to the backing plate with the 2 provided stainless steel screws.	
4. SECURE THE CHARGE CORD TO THE RECEPTICLE a. Pass the charge cord through the front area of the cabin vent. b. Secure the charge cord into the charge port receptacle and secure with a hose clamp.	
5. INSTALL THE EXHAUST DUCT a. Attach the exhaust duct to the exhaust manifold. b. Secure the exhaust duct to the stud with an M5 Keps nut.	
6. RECONNECT THE 12V GROUND WIRE.	

Chapter 5

Check-Out Procedures

This chapter includes the following sections:

Completing the Check List

Please supply the following information.

Module ID #: _____

Install Facility: _____

Technician: _____

Install Date: _____

Vehicle VIN#: _____

Customer Name: _____

Customer Contact #: _____

Required Items

The following items are required to run the checkout procedure.

- A laptop running Windows XP operating system
- An available USB port.
- Peak System PCAN to USB adapter. This adapter can be purchased from the following website: http://www.peak-system.com/db/gb/pcanusb_gb.html – part number *IPEH-002021*.
- ODBII to Serial adapter

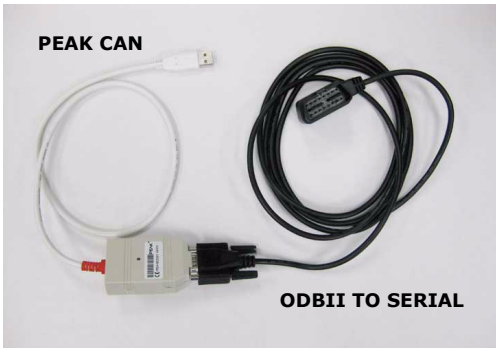


Figure 5-1 PEAK CAN adapter / ODBII to Serial adapter

Stationary Test

The stationary tests are as follows.

1. Verify the state of charge of the 12V battery.
   a. Trickle charge the 12V battery if it is below 12V..... ☐
2. Reinstall the orange OEM and Hymotion L5 service plugs..... ☐
3. Verify all vehicle connections.
4. Connect the bridge plug to the Hymotion vehicle-side harness..... ☐
   a. Start the vehicle. Verify the vehicle goes to **READY** mode without any issues or errors..... ☐

   NOTE: Refer toWiring and Connections on page 5-6 for more information.

   b. Press and hold the brake pedal. Verify all brake lamps are lit..... ☐
5. Turn off the vehicle.
6. Remove the bridge plug.
7. Connect the Hymotion L5 harness to the vehicle harness.

   NOTE: Refer to Installing the L5 PCM to the Vehicle on page 4-1 for more information.

8. Plug the charge cord into the vehicle and proceed as follows.
   a. Connect the PEAK CAN and ODBII adapters together as shown in Figure 5-1.
   b. Connect the PEAK CAN adapter to the USB port on the laptop.
   c. Connect the ODBII adapter to the ODBII port on the vehicle.
   d. Initiate the *L5_Install* software utility.

   NOTE: Refer to the Charge Cord Connection on page 5-9 for more information.

   e. Verify the following variables.

   "*ac_on*" = 1..... ☐

   "*fault_message*" = 0..... ☐

   "*state*" = 3..... ☐

   "*pack_power*" ramps up to 400W – 1000W after 2 minutes..... ☐

   "*battery_soc*" is between 25 and 75 percent ..... ☐

   f. Verify the three brake lights are dimly lit during the charging phase..... ☐
9. Press **START** with foot on brake.
   a. Verify the vehicle does not start with charge cord connected..... ☐
10. Disconnect the charge cord.
11. Press and hold the brake pedal for 5 seconds and release.
   a. Press the start button within 30 seconds and without the brake pedal depressed.

   The green illumination on the switch is displayed.
   b. Wait 5 seconds and press the start button again.

   The amber illumination on the switch is displayed.
   c. Verify the vehicle dash display illuminates with default settings..... ☐
   d. Verify the following variables.

   "*state*" = 2 ..... ☐

   "*fault_message*" = 0 ..... ☐

   NOTE: Refer to Global Variable Definitions on page 5-7 for "*state*" and "*fault_message*" information.

   NOTE: Locate the variables *prius_hv_contact* and *prius_hv_contact2* in the *L5_Install* software utility before proceeding with step 12.
12. Press the start switch for the 3rd time while holding the brake pedal.

   Leave the Hymotion L5 enable switch in the ON position.

- The **START** switch illumination disappears.
- The **READY** mode illuminates on the dash display.

a. The software displays the HV contactor sequence while starting the vehicle. Verify **Variable 1** is displayed before **Variable 2**.

Variable 1: "*prius_hv_contact*".....☐

Variable 2: "*prius_hv_contact2*".....☐

NOTE: If **Variable 2** is displayed before **Variable 1,** refer to Contactor Sequence on page 5-8.

b. Turn on the Air Conditioner and the headlights.

c. Verify the following variables.

"*system_enable*" = 1 .....☐

"*state*" = 5.....☐

"*fault_message*" = 0.....☐

"*battery_soc*" is between 25 and 75 percent .....☐

"*pack_power*" = between -300W and -10000W (after 2 minutes).....☐

"*box_on*" = 1.....☐

"*min_cell_voltage*" = between 2.8V and 3.6V.....☐

"*max_cell_voltage*" = between 2.8V and 3.6V.....☐

“*min*" and "*max*" cell voltages are within **0.05V** of each other .....☐

NOTE: Refer to Unbalanced Pack on page 5-8 for more information.

"*p_batt_v*" = between 170V to 245V.....☐

"*battery_amp_hrs*" = between 0.1 and 25.....☐

d. Probe for 12V on the Hymotion harness connector V1 pos 15.

NOTE: Refer to Faulty Connection on page 5-9 for more information.

Drive Test

The following steps require that the vehicle is driven in a test loop while a technician monitors the *L5_Install* software utility variables.

- Avoid highways on the drive test.
- Verify the Internal Combustion (IC) engine turns on at least once during the drive cycle.

1. The following verifies the Hymotion L5 module's power flow and EV mode engagement.
   a. Drive the vehicle on a flat 5-10 mile test loop until the following conditions are true.

      "*engine_warm*" = 1 .....☐

      "*pack_power*" reaches a minimum of -7000W during electrical acceleration.....☐

      Fuel economy at the end of test loop exceeds 80 mpg.....☐

2. The following verifies pack temperatures are read correctly while the vehicle is running.
   a. Verify the following conditions are true.

      "*min_cell_temperature*" is within 10°C of "*max_cell_temperature*".....☐

      "*air_inlet_temp*" is within 30°C of "*max_cell_temperature*".....☐

      "*box_temp*" is less than 55°C .....☐

   NOTE: Refer to Pack Temperatures on page 5-9 if temperatures are out of range.

Diagnostic Procedures

The following sections include L5 PCM diagnostic procedures for various issues.

Wiring and Connections

The following table provides diagnostics for wiring and connection issues.

Symptom	Problem	Solution
Relay clicks are not heard when starting the vehicle. A system DTC fault is posted.	Service plug is not inserted or seated correctly	Reinsert the service plug. Cycle vehicle on-off 5 times to clear fault.
Only one or two relay clicks are heard and a DTC is posted. Three clicks are necessary to start the vehicle (PreCharge, negative HV, and positive HV contactors).	Contactor signals are not properly connected.	Check continuity of contactor signals. Repair any wire faults.
Start switch not operational.	Disconnected interlock ground at OEM battery pack. Wrong connection at the start switch (i.e. Hymotion ground connected to vehicle harness and not the switch). Fault in the wiring connections to the start switch.	Check continuity of ground to start switch P11, pin 6. Switch should be grounded when bridge plug is inserted.
Communication error between HV ECU and OEM HV Battery. Vehicle starts but DTC is posted and engine turns on right away with full radiator fans.	CAN signals are wired backwards (CAN H to CAN L is switched on one of the CAN channels). CAN signals are improperly crimped resulting in a loose connection. Power to OEM Battery ECU is not present and ECU is receiving no power due to a faulty connection.	Check proper orientation and continuity of CAN signals. Verify power is present on B11 pos 1.

Failure to Start

The following table describes a diagnostic for a vehicle failure to start issue.

Symptom	Problem	Solution
Vehicle does not start and displays a warning and a DTC.	Check for power on V1 pin 5 and 16 with respect to chassis ground. Should see a minimum of 9.6V and a maximum of 14.6V. Inspect under the dash board, ABS fuse, and connections if power is not present on V1 pin 16. Check for ground to L5 PCM module.	• If power and ground are present and CAN is not present, than vehicle CAN is backwards (CAN H and CAN L swapped on both channels) • A loose CAN connection on the vehicle or L5 module side of the CAN bus.

Global Variable Definitions

Global variable definitions are as follows.

1. The *state* variables:
   - *Start* = 0
   - *Initialize* = 1
   - *Standby* = 2
   - *AC Connected* = 3
   - *Charge phase Complete* = 4
   - *Running with Charge* = 5
   - *Running without Charge* = 6
   - *Pack Discharged* = 7
   - *Pack Running – Discharged* = 8
   - *Pack Running – Discharged – Recharging* = 9
   - *AC Cord Connected* = 10
   - *AC Cord Connected – Pack Balancing* = 11
   - *AC PreCharge* = 12
   - *Fault* = 99

2. The *fault_message* variables are as follows.
    - *Current Sensor Fault* = 1
    - *BMS Fault* = 2
    - *DC-DC Converter Fault* = 3
    - *Cell Voltage Error* = 4
    - *CAN Communication Fault*=5
    - *Battery Temperature Error* = 6
    - *AC PreCharge Fault* = 7
    - *Crash Sensor Set Off* = 8
    - *Service Plug Not Seated* = 9
    - *BMS Auto Address Fault* = 10
    - *Low Battery Cell Voltage* = 11
    - *Battery CAN Communications Fault* = 12
    - *Vehicle CAN Communications Fault* = 13
    - *12v Vehicle Battery Low* = 14
    - *Over Current Fault* = 15
    - *Module Over Voltage Fault* = 16

Contactor Sequence

The following table provides a diagnostic for a contactor sequence issue.

Symptom	Problem	Solution
L5 Module remains in "*state*" 2 and does not progress to "*state*" 6 and "*state*" 5 upon startup.	Contactor sequence is backwards. Variable 2 is seen before Variable 1.	Swap V1 pin 6 & 7 to correct the polarity issue on the installation harness.

Unbalanced Pack

The following table provides a diagnostic for an unbalanced pack issue.

Symptom	Problem	Solution
"*min_cell_voltage*" and "*max_cell_voltage*" differ by more than 0.05V	Battery pack is unbalanced.	Replace the battery pack.

Faulty Connection

The following table provides a diagnostic for a faulty connection issue.

Problem	Solution
EV button wire has faulty connection.	Verify that 12V is present at V1 pin 15 (with respect to chassis ground) when vehicle is powered on. If 12V is present, drive the vehicle until EV mode is achieved.

Pack Temperatures

The following table provides a diagnostic for a pack temperature issue.

Symptom	Problem	Solution
Battery pack temperatures are out of range.	Blocked air inlet vent or exhaust duct.	Verify there is no blockage in the air inlet vent or inside the exhaust duct. Verify air flow is exiting the Hymotion exhaust duct.

Charge Cord Connection

The following table provides a diagnostic for a charge cord issue.

Symptom	Problem	Solution
"*ac_on*" is not displayed.	The charge cord connection is faulty.	Verify the charge cord is properly connected.

Chapter 6

Firmware Update Procedures

This chapter includes the following sections:

Introduction

The L5 PCM Battery Management System (BMS) keeps track of key operational parameters that occur during the charge and discharge cycle. The BMS could require firmware upgrades. This chapter details installing firmware on the BMS.

Firmware Update Procedure

This section describes the required items and the pre-install environment necessary for upgrading the firmware.

Required Items

The following items are required to upgrade firmware in the BMS.

- A laptop running Windows XP operating system
- An available USB port.
- Tripp-Lite USB to Serial adapter.

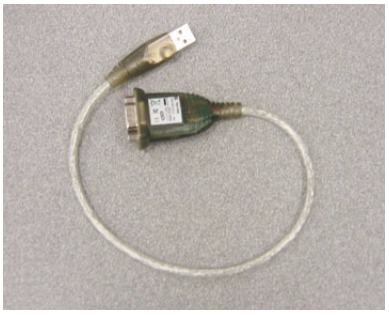


Figure 6-1 Tripp-Lite adapter

- A123System supplied firmware (*.H86).

Pre-Upgrade Environment

Verify the following conditions are met prior to installing the firmware in the BMS.

1. Turn off the vehicle.
2. Remove the service plug.
3. Plug in the vehicle to the electrical outlet.
4. Verify the Tripp-Lite adapter drivers are installed. See Appendix C for adapter installation details.
5. Verify the IFM Downloader is installed. See Appendix D for installation details.

Running the A123 System's Firmware

Install A123 System's firmware as follows.

1. From Windows go to *START / All Programs / Shortcut to DOWNLOAD.exe*.

   Figure 6-2 is displayed.

Figure 6-2 Download screen

2. Under *Interface*, select the radio button for RS232.

   Figure 6-3 is displayed.

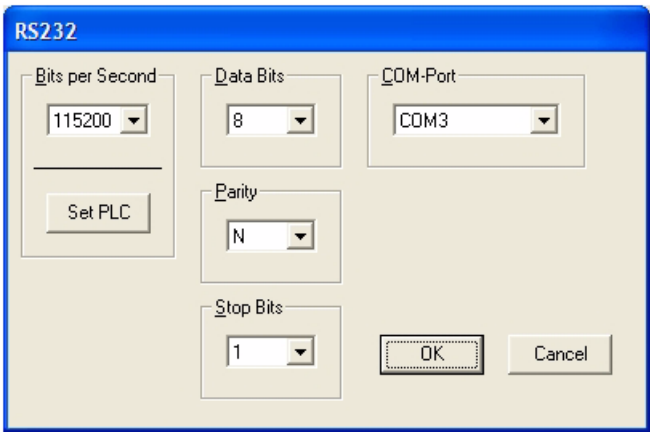


Figure 6-3 RS232 parameters

3. On the *Bits per Second* pull-down:
   - Select 115200
4. On the *Data Bits* pull-down:
   - Select 8
5. On the *Parity* pull-down:
   - Select N
6. On the *Stop Bits* pull-down:

- Select 1

7. On the *COM-Port* pull-down*:*
   - Select the COM port where the adapter is connected.

   NOTE: Use Window's Device Manager to discover the communication port that was assigned to the USB/Serial adapter. Make note of the assigned communication port.
8. Select OK.

   The RS232 screen closes.
9. Reference the Download screen that is displayed in Figure 6-2 on page 6-3:
   a. Select the **Open / File** button
   b. Select the program file having an *.H86 extension.

Completing the Installation

Complete the installation as follows.

1. Connect the serial end of the Tripp-Lite adapter to the DB9 connector port on the driver's side of the pack.
2. Reference the Download screen that is displayed in Figure 6-2 on page 6-3:
   a. Select the **Identity** button

      Selecting the **Identity** button tests the communications to the controller.

      NOTE: Do not proceed until proper communications have been established.
   b. Select the **Download** button.

      This starts the download procedure and takes approximately 10 seconds.
   c. Select the ***Run*** button when the download has completed.

      This completes the installation and the charging process resumes.

Appendix A

Installation Harness Pin-Outs

The installation harness pin assignments are described in this appendix.

Pin-Assignment Table

Table A-1 provides the installation harness pin assignments.

Table A-1 Pin-assignments

Pin	Color / Length	Function
1	Not used	
2	Not used	
3	Brown – 376 cm	Dash Light Indicator (12V) – Connects to dash light indicator
4	Red – 177 cm	Brake Light Indicator (12V) – Connects to R9 pin 5
5	Violet – 41 cm	Unswitched Power (12V Battery) – Connects to B11 pin 1
6	Green – 41 cm	System Main Relay Signal (12V) – Connects to System Main Relay Harness (green wire)
7	Yellow – 41 cm	System Pre Charge Relay Signal (12V) – Connects to System Main Relay Harness (yellow wire)
8	Black w/ ring term. – 65 cm	Interlock Ground - Connects to OEM Battery ECU mounting screw (Vehicle Ground)
9	Yellow twisted w/black – 41 cm	Battery CAN L – Connects to connector side of B11 pin 19
10	Black twisted w/yellow – 41 cm	Battery CAN H – Connects to connector side of B11 pin 18
11	Black twisted w/blue – 41 cm	Vehicle CAN H – Connects to vehicle side of B11 pin 18
12	Blue twisted w/black – 41 cm	Vehicle CAN L – Connects to vehicle side of B11 pin 19
13	Grey – 407 cm	Start Button Interlock – Connects to connector side of P11 pin 6
14	Orange – 376 cm	Hymotion System Enable – Connects to Dash Switch
15	White – 539 cm	EV Button Signal – Connects to H 14 pin 27
16	Blue – 376 cm	ABS Remote Power – Connects to S10 pin 7

Appendix B

Installing PEAK CAN Adapter Driver

Install the Adapter Driver

Install the PEAK CAN to USB adapter drivers as follows.

1. Insert the supplied CD into a PC or laptop.
2. Install the PEAK CAN to USB adapter's drivers.
3. Select Finish to complete the installation.
4. Copy *PCAN_PCI.dll* from the CD to a local directory. Path to the file is as follows.

   [*CD Drive*]:*Develop**Windows**PCI*\ *PCAN_PCI.dll*
5. Remove the CD.

Appendix C

Installing the Tripp-Lite Adapter Driver

Install the Adapter Driver

Install the Tripp-Lite adapter driver as follows.

1. Connect the adapter to a USB port on a laptop.

   Figure C-1 is displayed on your laptop.

Figure C-1 New hardware wizard

2. Select the *Install from a list or specific location* radio button.
3. Select the **Next** button.

   Figure C-2 is displayed.

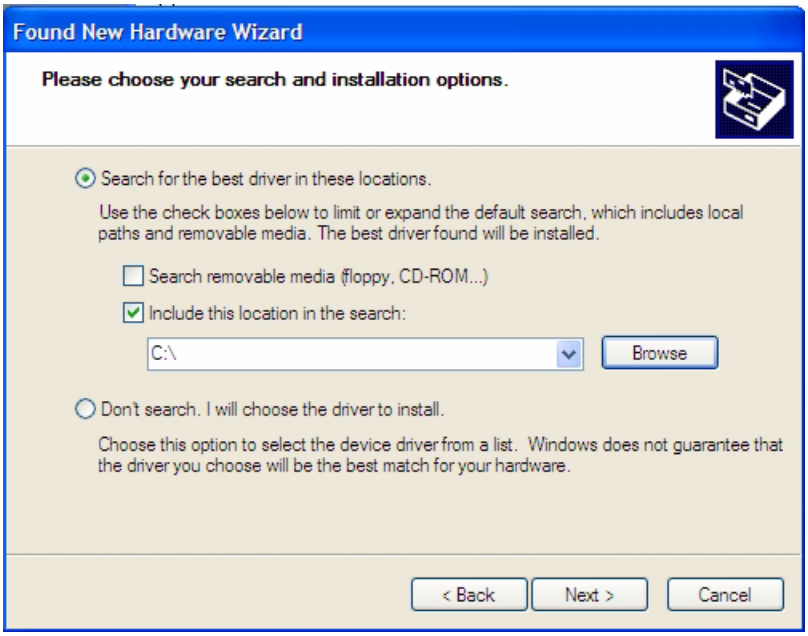


Figure C-2 Installation options

4. Select *Search for the best driver in these locations* radio button.
5. Select *Include this location in the search* check box.
6. Browse to the A123System's supplied location.
7. Select the **Next** button.

   Figure C-3 is displayed.

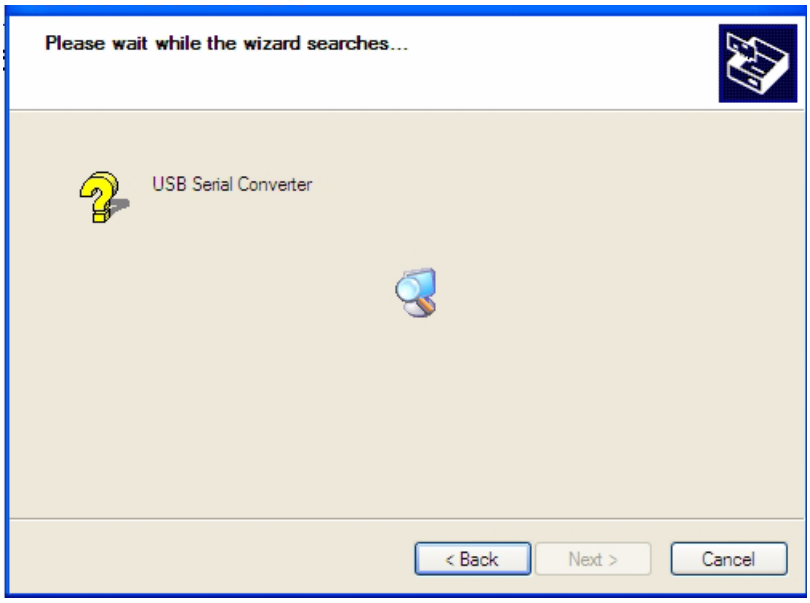


Figure C-3 Search screen

8. Wait while the wizard searches for the correct location. This could take several minutes.

   Figure C-4 is displayed.

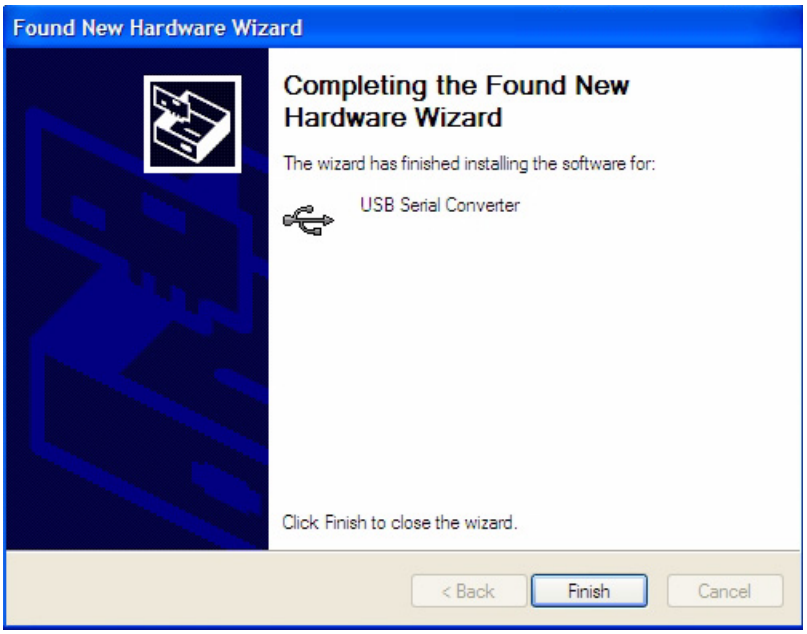


Figure C-4 Completed screen

9. Select the **Finish** button.

NOTE

Use Window's Device Manager to discover the communication port that was assigned to the USB/Serial adapter. Make note of the assigned communication port.

Appendix D

Installing the IFM Downloader

Install the Downloader

Install the downloader as follows.

1. Retrieve from the ftp website.
2. Copy *download.exe*, *download.msi*, and *download.cfg* to a local directory.
3. Run *download.msi*.

   Figure D-1 is displayed.

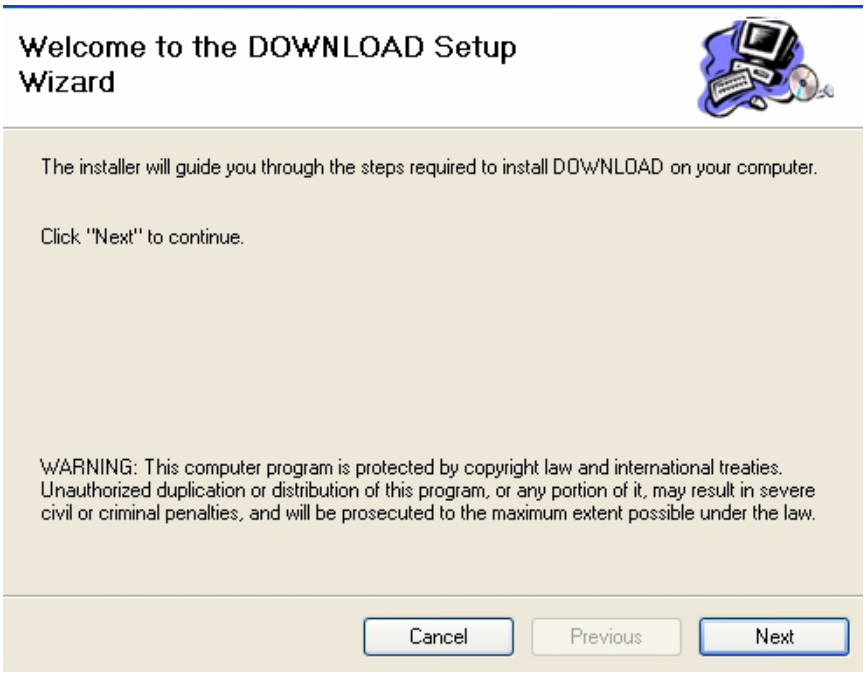


Figure D-1 Install Shield

4. Select the **Next** button to begin installing the downloader.

   Figure D-2 is displayed.

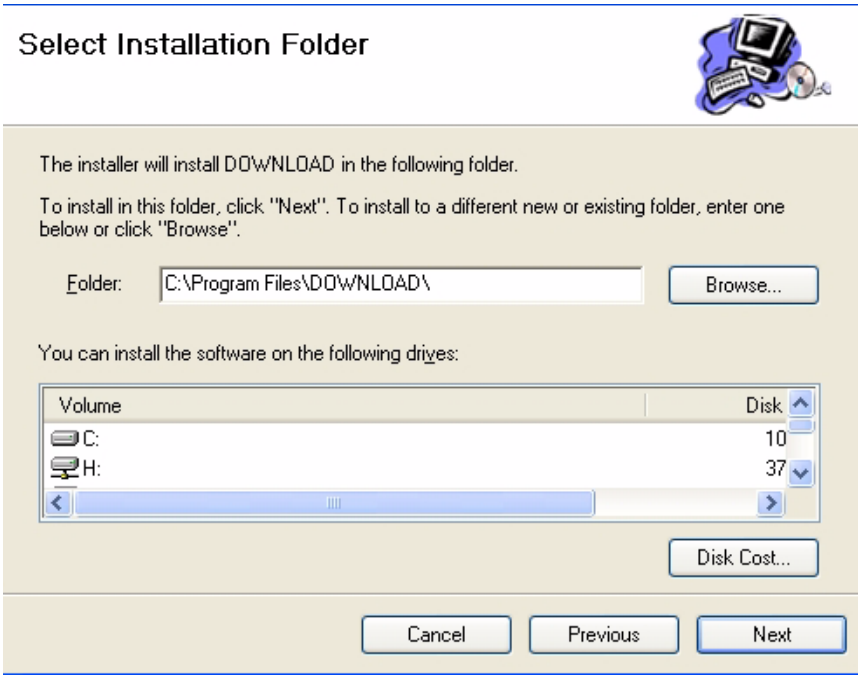


Figure D-2 Customer information

5. The destination folder location defaults to *C:\Program Files\DOWNLOAD*. Keep this location.
6. Select the **Next** button.

   Figure D-3 is displayed.

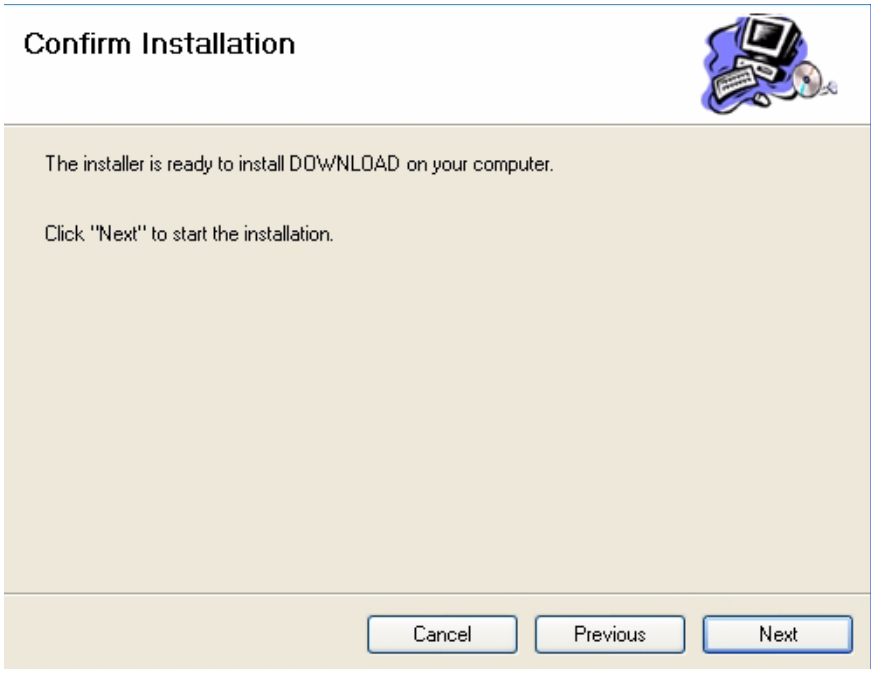


Figure D-3 Destination folder

7. Select the **Next** button to confirm the installation.

   The program installs as shown in Figure D-4.

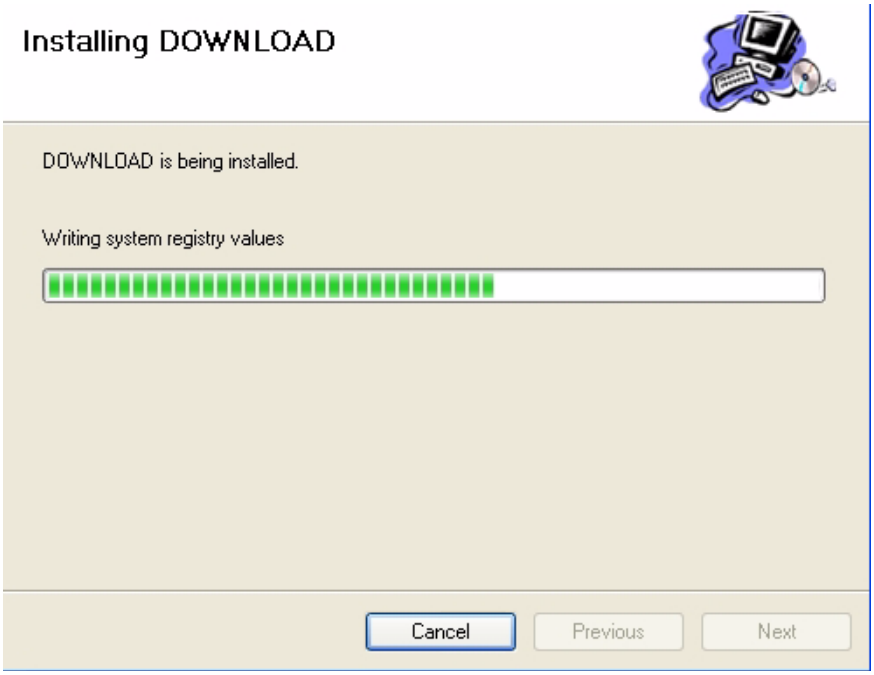


Figure D-4 Begin installation

8. Select the **Next** button when the installation completes.

   Figure D-5. is displayed.

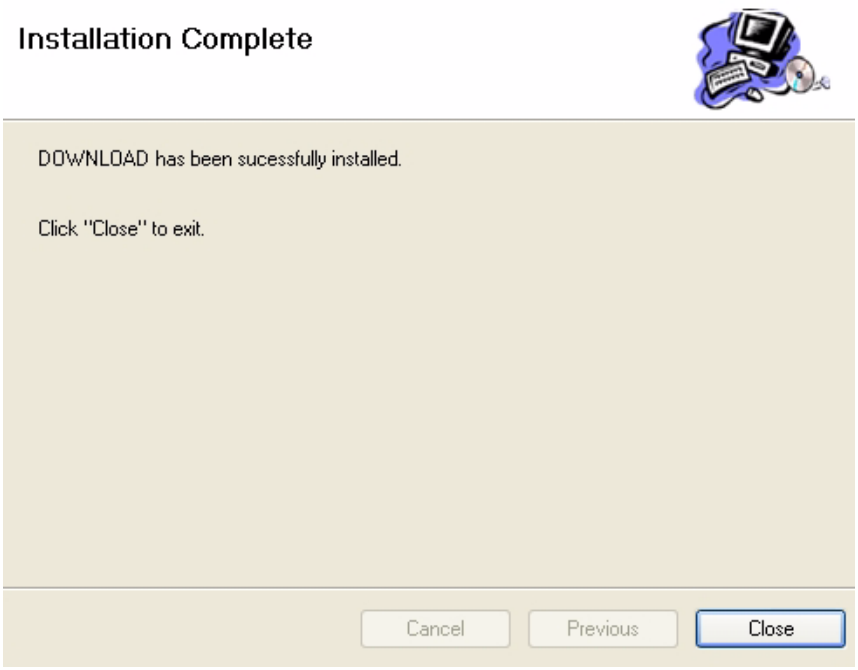


Figure D-5. Installation complete

9. Select the **Close** button to exit the downloader.